7. NONRADIOACTIVE AND THERMAL EMISSIONS COMPARED TO STANDARDS

EFFECTS OF RELEASES TO THE ATMOSPHERE

The primary nonradioactive materials that are released to the atmosphere from SRP operations are SO_2, fly ash, and NO_x from steam and power plants; NO and NO_2 from 200-Area separations processes; NO, NO_2, and HNO_3 mist from 300-Area fuel fabrication processes; and H_2S from the 400-Area heavy water plant.

SO_2

A comparison of the South Carolina emission standard with emissions of SO_2 from the various onsite coal burning facilities indicates that the SRP facilities operate within the published standard (Table III-20). The calculated contributions to the annual average SO_2 ambient air concentration at the SRP boundary total less than 33 $\mu g/m^3$ (Table III-21); the South Carolina and Georgia annual average concentration standards are 80 and 43 $\mu g/m^3$, respectively.

A program of ambient air measurements of SO_2 at six monitoring sites (Figure III-13) was carried out during May 1973 to February 1974.[25,26] The observed SO_2 concentrations at the two Georgia sites (1 and 2) and at the four South Carolina sites (3, 4, 5, and 6 within SRP) did not exceed the respective state standards, below. However, statistical extreme value analysis of the limited data collected at Site 3 near the South Carolina-Georgia border indicated the possibility of exceeding the Georgia one-hour standard (715 $\mu g/m^3$) at a frequency of less than twice a year and the South Carolina three-hour standard (1300 $\mu g/m^3$) not more than once in ten years. The South Carolina standard and the national secondary standard are the same, and it is allowable to exceed them once per year. Additional data will be collected at Site 3 to enable a better prediction of extreme SO_2 concentrations at that location. This site is an ideal location for data acquisition because it is near the estimated point of maximum ground level concentration of SO_2 from the major source (D-Area power plant), and it is near enough to Georgia to be indicative of offsite concentrations.

Fly Ash

Particulate emissions from all fuel-burning facilities are summarized in Table III-22. Due to the size of the SRP site, most of the fly ash emissions from these plants are deposited onsite, but 7 of the 12 coal-burning facilities exceed South Carolina emission standards. Electrostatic precipitators were

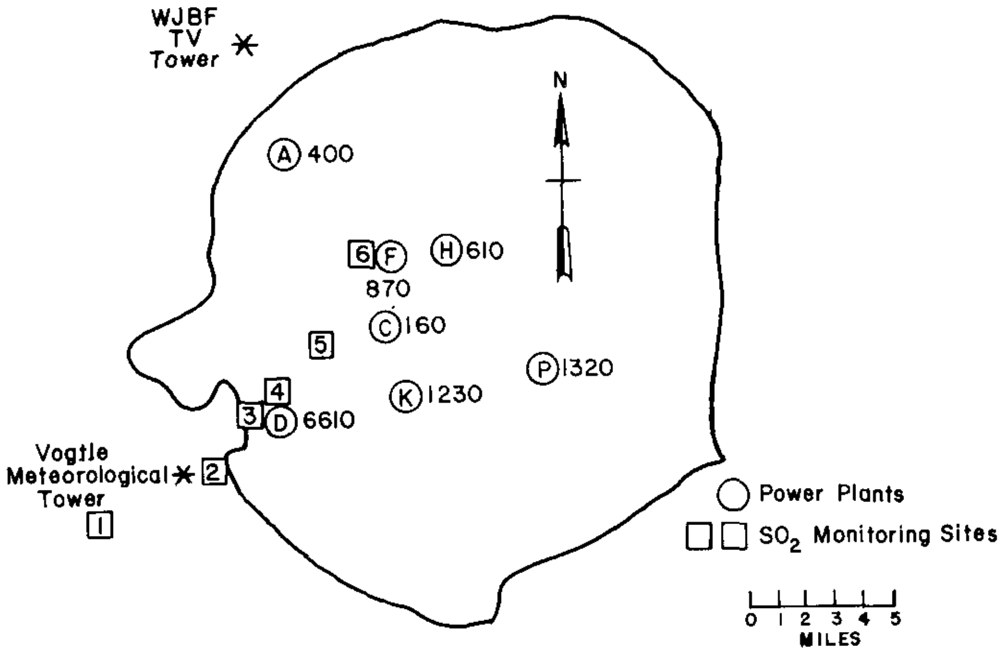

FIGURE III-13. Coal-Fired Power Plants at SRP and Sulphur Dioxide Monitoring Sites, 1973-74. (Also shown are the average annual emissions of SO_2 in tons.)

installed during 1975 on the four large pulverized coal boilers in 400 Area. These units remove more than [*K.9*] 99% of the particulate material discharged from the smoke stacks and ensure conformance with South Carolina emission standards. Particulate removal from the stoker-fired boilers (all other steam and power plants) is under study. Prototype improvements on the A-Area units are being installed and will be tested in 1977. The collected ash will be added to ash basins.

NO_x

Calculated contributions to the ambient air concentration at the plant perimeter are listed in Table III-23 for each NO_x source. The calculations[27] are based on releases from operations (Table III-24) and meteorological data collected over a two-year period (Appendix F). The calculated values represent annual average meteorological conditions and indicate a SRP contribution of less than 23% of the South Carolina or Georgia annual average ambient air standard (100 $\mu g/m^3$) at the plant perimeter.

TABLE III-20

SO_2 Emissions From Fuel Burning Operations at SRP

Area	*Stack No.*	*Rated Boiler Input, 10^6 Btu/hr*	*Actual Boiler Input,[a] 10^6 Btu/hr*	*Emission[b]*		*South Carolina Emission Standards,[28] lb/10^6 Btu*
				lb/hr	*lb/10^6 Btu*	
400-D	1	396	231.7	502.7	2.17	3.5
	2	396	231.7	502.7	2.17	3.5
	3	396	231.7	502.7	2.17	3.5
	4	396	231.7	502.7	2.17	3.5
100-C	1	87.6	16.4	28.2	1.72	3.5
100-K	1	389	135.0	232.0	1.72	3.5
100-P	1	389	134.1	236.2	1.72	3.5
200-F	1	143.4	43.0	73.9	1.72	3.5
	2	143.4	43.0	73.9	1.72	3.5
200-H	1	143.4	55.7	95.7	1.72	3.5
	2	71.7	28.0	48.0	1.72	3.5
700-A	1	143.4	52.8	90.7	1.72	3.5
CMX-TNX	1	20.8 (No. 2 fuel oil)	5.0	0.2	0.04	3.5

a. Actual annual average heat input.
b. Annual average.

TABLE III-21

Calculated Contributions to Annual Average SO_2 Ambient Air Concentration at SRP Boundary

Area	*Calculated Contributions, μg/m³*
400-D	30
100-C	0.04
100-K	0.36
100-P	0.33
200-F	0.17
200-H	0.14
700-A	2.0

TABLE III-22

Particulate Emissions From Fuel Burning Operations at SRP

Area	*Stack No.*	*Rated Boiler Input, 10^6 Btu/hr*	*Actual Boiler Input,[a] 10^6 Btu/hr*	*Emission lb/hr*	*Emission lb/10^6 Btu*	*South Carolina Emission Standards,[28] lb/10^6* Btu
400-D	1	396	231.7	644.1	2.78	0.6
	2	396	231.7	644.1	2.78	0.6
	3	396	231.7	644.1	2.78	0.6
	4	396	231.7	644.1	2.78	0.6
100-C	1	87.6	16.4	20.9	1.27	0.6
100-K	1	389	135.0	229.5	1.70	0.6
100-P	1	389	134.1	228.0	1.70	0.6
200-F	1	143.4	43.0	24.5	0.57	0.6
	2	143.4	43.0	21.5	0.50	0.6
200-H	1	143.4	55.7	31.7	0.57	0.6
	2	71.7	28.0	11.8	0.42	0.6
700-A	1	143.4	52.8	30.1	0.57	0.6
CMX-TNX	1	20.8 (No. 2 fuel oil)	5.0	0	0	0.6

a. Actual annual average heat input.
b. Annual average.

TABLE III-23

Calculated Contributions to Annual Average NO_x Ambient Air Concentration at SRP Boundary

Source	*Calculated Contributions, μg/m³*
700-A Powerhouse	<1
300-M Processing	1
200-F Powerhouse	<1
200-F Processing	<1
200-H Powerhouse	<1
200-H Processing	<1
100-P Powerhouse	<1
100-K Powerhouse	<1
100-C Powerhouse	<1
400-D Powerhouse	14

TABLE III-24

NO_x Emissions at SRP

Operation	*Area*	*Major Component*	*NO_x, tons/yr*
Coal Combustion	D	NO	3400
Coal Combustion	F	NO	320
Coal Combustion	H	NO	280
Coal Combustion	P	NO	450
Coal Combustion	K	NO	450
Coal Combustion	C	NO	65
Coal Combustion	A	NO	190
U Dissolving; $UO_2(NO_3)_2 \rightarrow UO_3$	F	NO_2	180
U-Al Dissolving	H	NO	100
U Cleaning	M	NO_2	6
Al Cleaning	M	NO-HNO_3	1
Fuel Oil, Motor Vehicles, and Miscellaneous		NO	70
		Total	∿5500

H_2S

Routine operation of the heavy water plant results in the release of about 11 tons of H_2S per month. Most H_2S releases are vented to the atmosphere through a 400-ft flare tower. About 30% of the H_2S is ignited in the flare tower to produce SO_2 and a buoyant plume. This buoyancy increases the dispersion of the gas and reduces the probability of offsite and onsite effects. The resulting SO_2 releases are less than those from the smaller boilers listed in Table III-20.

The highest rate of routine release of unburned H_2S occurs when vessels containing H_2S dissolved in water are purged at infrequent intervals (about 4 times per year). Under these conditions the amount purged would be about 300 lb from the 400-ft tower within a minimum time period of 10 minutes. If neutral buoyancy is assumed for the H_2S plume, the maximum concentration at ground level occurs at a distance of about 4 km. Using methods similar to those discussed in Appendix F and assuming the most adverse meteorological dispersion conditions, the ground-level dilution factor at 4 km is estimated to be 3.0×10^{-5} sec/m^3. The release of 300 lb in 10 minutes yields a source term of 2.27×10^8 μg/sec resulting in a ground-level concentration at 4 km of 6.8×10^3 μg/m^3 or about 4.9 ppm. This represents an estimate of the maximum ground-level concentration.

The probability of causing an offsite ground-level concentration in the 5 ppm range is very low because: 1) The release has to occur under very stable meteorological conditions with very low wind velocities. This meteorological condition is generally conducive to plume meandering which tends to reduce peak exposures to short time intervals compared to the total assumed 10-minute release period. 2) The estimate of 4.9 ppm is based on an average wind velocity of 0.5 m/sec. The frequency of occurrence of wind speeds less than 1 m/sec at an elevation of 400 ft is about 3%.[29] 3) The wind direction must be toward a specific direction to have the plume intersect the plant boundary within a distance of 4 km (see Figure II-2). The minimum distance to the plant boundary from the flare tower is about 2 km.

The estimate of 4.9 ppm may be compared to values listed below expressing effects of H_2S as a function of concentration and time. Although 4.9 ppm is in the range detectable by odor, it is below the threshold value of detectable physical effects given as 10 ppm and 8 hours exposure. An exposure of 5 ppm for 10 minutes is only about 1% of the threshold limit as given.

Due to the combination of circumstances necessary to cause this ground level concentration, the odor will rarely be detected offsite. Probability analyses similar to those contained in Reference 29 indicate the dilution factor that is not exceeded 95% of the time at a distance of 4 km to be about 1.5×10^{-6} sec/m^3. This yields a concentration estimate at this distance of 0.24 ppm, which is unlikely to be experienced offsite because the prevailing wind direction is from east to southeast. It is concluded that even under these assumed release conditions, routine H_2S releases from SRP present no significant offsite hazard.

Concentration, ppm	*Time*	*Effect*
0.13	Sniff	Odor detectable
10.0	8 hours	Threshold limit
50-100	1 hour	Mucous membrane irritation
200-300	1 hour	Mucous membrane irritation (severe)
500-700	1/2 hour	Coma
900	Minutes	May be fatal
1000	Minutes	Fatal

Release of H_2S gas from equipment failure at the heavy water plant can occur. A release of 3 tons occurred in one incident in 1975 during a 10-minute period. The H_2S gas was vented through the flare tower, ignited, and released to the atmosphere as SO_2 gas. Meteorological calculations showed that the maximum SO_2 concentration at a distance of 1.6 km (within the SRP boundary) would be about 200 ppb. This value would not exceed the applicable South Carolina standard.

The other releases of H_2S in 1975 consisted of losses to waste water ranging from 100 lb to 1 ton and totaling 10 tons. This waste water is discharged through a pipeline that outfalls onsite into Beaver Dam Creek. Environmental studies to evaluate such releases are underway.

In twenty-two years of process operation, five major gas releases (greater than 5 tons) have occurred. The latest and largest of these occurred in 1960 when a 16-inch pipe connection broke releasing 46 tons of H_2S gas. This gas leaked out and ignited near ground level. The resulting SO_2 dispersed over the SRP and caused no known adverse effects onsite or offsite.

Hydrocarbons

Photochemically reactive hydrocarbon emissions from SRP sources consist of trichloroethylene from the 200 and 700 areas and the Savannah River Laboratory. Quantities released per year are given in Appendix B; the separations area sources are seen to be the most significant releases. The perchloroethylene used in the fuel fabrication and reactor areas is less photochemically reactive. The South Carolina ambient air standard for nonmethane hydrocarbons is 130 $\mu g/m^3$, maximum 3-hr average. Estimated SRP contributions to the ambient air concentration, calculated using a 3-hr release rate of 3.0 lb of trichloroethylene for the 200 areas, 2.5 lb for the 700 area, and 3.4 lb for the Savannah River Laboratory, are maxima at the SRP perimeter of 0.4, 6.2, and 8.5 $\mu g/m^3$, maximum 3-hr average. These calculations were made by the same methods used above for H_2S for most adverse meteorological conditions, but assuming a release height of 10 meters as appropriate for these releases. The calculational technique resulted in peak plume centerline concentrations which were subsequently adjusted by a factor of 0.33 to correspond to a 3-hr average-to-peak ratio determined from SO_2 ambient air measurements.

The use of trichloroethylene is currently under review from the standpoint of industrial hygiene. A new vapor degreaser, currently on order for use at SRL, will use perchloroethylene and will reduce SRL consumption of trichloroethylene. Similar conversions have been completed in the 300 and 100-areas.

The use and disposal of polychlorinated biphenyls (PCB) at SRP has been specifically controlled since 1972. The only routine disposal of PCB is in discarded ballasts from fluorescent lighting fixtures; these ballasts are buried at one location near the center of the site. The nearest stream, Pen Branch, is 1500 ft from the disposal pit. Analyses of plant streams and the Savannah River have not detected PCB in the water, but sediments in the river and in two plant streams (Four Mile Creek and Pen Branch) have contained PCB at 5 to 130 parts per billion. The small amount of data available are from grab samples taken once each year; evaluation is difficult except for long-term trends. Offplant sources may be the primary contributors of PCB in Four Mile Creek and Pen Branch because the Savannah River is the principal source of water for both streams.

OFFSITE EFFECTS OF RELEASES TO PLANT STREAMS

Chemical Releases

The sources of nonradioactive chemicals released to plant streams were discussed in Section II. Quantities released to surface streams are summarized in Table III-25. More-detailed tables are included in Appendix B. Calculations of the concentration changes in Savannah River water from various components of concern in Public Health Service Drinking Water Standards[30] illustrate the negligible effect of these discharges compared to the Standards (Table III-26). The actual concentrations in the river are all below the Standards.

In addition to effects on drinking water, discharges may also affect algae growth. Two of the constituents that influence algae growth are nitrates and phosphates. Comparison of the calculated contributions of nitrates and phosphates to the Savannah River from SRP operations with measured concentrations indicate that the SRP contributions are small (Table III-27).

TABLE III-25

Chemicals Released to Surface Streams on SRP in 1975[a]

	Quantity, lb	*Source*
Sulfate	1,980,000	Acid and aluminum for water treatment
Chloride	486,000	Water treatment
Phosphate	34,000	Water treatment
Boron	2,000	Reactor - "Polybor"
Manganese	1,100	Heavy Water Plant - Permanganate
Chromate	1,100	Chilled Water Systems
Nickel	2,800	Fuel and Target plating
Aluminum hydroxide	600,000	Alum for water treatment

a. This table does not include materials in effluent from coal ash basins. Total effluent water from those basins is about 10^{10} lbs per year; dissolved materials include: sulfate, 50 ppm; aluminum, 2 ppm; calcium, 2 ppm; iron, 0.5 ppm. Other elements in the range 20 to 50 ppb include: arsenic, barium, boron, cadmium, lead, and zinc.

TABLE III-26

Comparison of Changes in Savannah River Water Quality with Drinking Water Standards[30]

(Assumes all materials discharged to streams reach the Savannah River)

Material	*Change in Savannah River Concentrations Resulting From SRP Release, ppm*[a]	*Drinking Water Standard, ppm*
Sulfate	0.2	250
Chloride	0.05	250
Nitrate	0.01	10
Phosphate	3×10^{-3}	*c*
Barium	1.7×10^{-3}[d]	1.0
Iron	4.9×10^{-4}	0.3
Boron	1.8×10^{-4}	1.0
Zinc	1.5×10^{-4}	5
Chromium	4×10^{-5}	0.05
Manganese	9×10^{-5}	0.05
Arsenic	1×10^{-5}	0.05
Mercury	9×10^{-8}	0.002
Copper	1.3×10^{-6}	1
Phenols	1.7×10^{-7}	0.001
Cyanide	*b*	0.2
Cadmium	*b*	0.01
Lead	*b*	0.05
Selenium	*b*	0.01
Silver	*b*	0.05

a. Assumes minimum flow of 6000 cfs. Concentrations downstream of SRP are all below the standards.

b. Not normally discharged to streams at SRP.

c. No drinking water standard at present time.

d. $10^{-3} = 0.001$, $10^{-4} = 0.0001$, etc.

TABLE III-27

Concentrations of Nitrates and Phosphates in the Savannah River

January - December 1975

	Savannah River Upstream of SRP	*Savannah River Downstream of SRP*	*Calculated Plant Contribution*[a]
Nitrate, ppm	0.7	0.7	0.01
Phosphate, ppm	0.6	0.5	0.006

a. Assumes 6000 cfs flow in the Savannah River.

Sewage

The offsite impact of SRP sewage handling operations would normally be measured by changes in fecal coliform count in the Savannah River; however, this effect is masked by the large quantities of river water heated by reactor operations. The Savannah River coliform content upstream of SRP exceeds the S. C. Standards for Class B streams (1000 colonies/100 ml) much of the time, and the maximum fecal coliform content of SRP streams receiving reactor cooling water represents the excessive coliform counts present in the river (Table III-28). However, when the reactors are operating, the coliform content of reactor effluent streams is reduced below levels in the Savannah River because of the heat. Upper Three Runs, an on-plant stream receiving effluent from the sewage plant serving the administrative and technical areas (300/700 Areas) (but no reactor cooling water) has a mean coliform content of <100.

An extensive upgrading of the sanitary waste water treatment facilities was completed in 1975. The upgrading consisted of installing secondary treatment facilities and chlorination of the effluents in six locations and installing tile fields in other areas. This upgrading has an insignificant effect on the coliform count in the Savannah River.

Pesticides

Arrangements were made beginning in 1971 for the United States Geological Survey (USGS) Water Quality Laboratory, Washington, D. C., to analyze annually water and sediment from SRP streams and the Savannah River for pesticides. Water samples were previously analyzed for pesticides by the Federal Water Pollution Control Administration (now Environmental Protection Agency) at Athens, Georgia, and all results were less than the sensitivity of the analyses. Analyses are currently done by the USGS in Atlanta, Georgia.

Results of water samples collected in December 1975 showed no detectable concentrations in stream and river water. Sediment showed trace quantities of DDD, DDE, DDT, and Dieldrin, which are agricultural pesticides and are not used at SRP. The quantities of pesticides detected in river sediment by gas chromatographic water analyses at the USGS laboratory are shown in Table III-29.

Ash Basins

Effluents from ash basins to plant streams have been analyzed, and indicate measurable quantities of various environmentally significant materials. Table III-30 lists these analyses and compares them with standards for drinking water.

TABLE III-28

Fecal Coliform Bacteria Measurements

(Weekly Samples, Colonies/100 ml)

	January 1 thru December 31, 1975		
	Maximum	*Geometric Mean*	*Minimum*
Savannah River			
Upstream from SRP	26,000	2,300	110
Highway 301 Bridges	1,200	440	<10
Upper Three Runs			
SRP Road F	530	90	0
SRP Road A	1,400	120	20
400-D Area Effluent	8,600	830	0
Four Mile Creek - Road A	4,600	450	0
Pen Branch - Road A	6,600	80	0
Steel Creek - Road A	1,800	130	0
Lower Three Runs			
Tabernacle Church Road	4,400	100	10
Road A	3,400	350	10

TABLE III-29

Pesticides Analyzed by USGS[a] in 1975

	River Sediment, μg/kg	
	Above Plant	*Below Plant*
Aldrin[b]	*d*	*d*
Chlordane[b]	*d*	*d*
DDD[b]	1.0	3.2
DDE[b]	1.2	3.4
DDT[b]	1.3	4.1
Diazinon[b]	*d*	*d*
Dieldrin[b]	0.5	1.4
Endrin[b]	*d*	*d*
Ethion[b]	*d*	*d*
Ethyl-Parathion[b]	*d*	*d*
Ethyl-Trithion[b]	*d*	*d*
Heptachlor[b]	*d*	*d*
Heptachlor-Epox[b]	*d*	*d*
Lindane[b]	*d*	*d*
Malathion[b]	*d*	*d*
Methoxychlor[c]	*d*	*d*
Methyl-Parathion[b]	*d*	*d*
Methyl-Trithion[b]	*d*	*d*
PCB[b]	*d*	9.0
PCN[b]	*d*	*d*
Silvex[b]	*d*	*d*
Toxaphene[b]	*d*	*d*
2, 4-D[b]	*d*	*d*
2, 4-DP[b]	*d*	*d*
2, 4, 5-T[b]	*d*	*d*

a. Limit of sensitivity of each analysis is 0.1 μg/ℓ of water and 1.0 μg/kg of sediment.

b. Water and sediment analyses.

c. Water analyses only.

d. Below limit of sensitivity.

TABLE III-30

Spark Source Mass Spectrometer Measurements on Ash Basin Effluent Water, ppm

Element	*P Reactor Area*	*Heavy Water Area*	*200-F*	*Drinking Water Standard*
Aluminum	0.2	0.53		
Arsenic	0.06[a]	0.07[a]		0.05
Barium	*0.13	1.3[a]		1.0
Boron	*0.04	*0.09		1.0
Cadmium	*0.02	*0.05		0.01
Calcium	10	3	18.7	
Chromium	*0.02	*0.03	0.009	0.05 (hexavalent)
Copper	*0.03	*0.02		1.0
Fluorine	*0.07	*0.007		1.4
Iron	0.23	0.37[a]	0.09	0.3 (filterable)
Lead	*0.03	*0.05		0.05
Magnesium	0.53	1.6	7.3	
Manganese	*0.006	*0.007		0.05 (filterable)
Mercury	*0.002	*0.002		0.002
Molybdenum	*0.025	0.24		
Nickel	*0.05	*0.02	0.036	
Potassium	20	2.7	5.16	
Selenium	*0.02	0.02[a]		0.01
Silver	*0.015	*0.012		0.05
Sodium	2.3	2.5	3.81	
Sulfate		50		250
Vanadium	0.05	0.12		
Zinc	*0.07	0.11	0.045	5

* Denotes mass lines present but not confirmed to be due to indicated element.

a. Values exceed standard.

EFFECTS OF FOREST MANAGEMENT

Favorable Environmental Effects

A managed forest is a dynamic community of plants and animals that has many favorable environmental effects. The forest products that would be lost to insects, decay, and natural mortality in an unmanaged forest are utilized to improve man's living conditions by providing building materials, cellulose for paper, furniture stock, etc. Areas regenerated provide forage for most species of wildlife. A managed forest produces a fairly constant amount of forage and forest products, while an unmanaged forest produces these subject to the chances of nature. Protection from fire, insects, and disease is superior in a managed forest. The chances for large fires resulting in adverse effects on the environment is reduced.

Adverse Environmental Effects

The visual impact of newly constructed roads and recently harvested timber are environmental effects that cannot be entirely avoided. These impacts are lessened by fitting the regeneration areas to the natural landscape. Within several years after harvesting a stand of trees, another stand is established. A temporary increase in turbidity of adjacent streams could occur from road construction activities. This is held to acceptable levels by recognizing soil instability and planning, designing, constructing, and maintaining roads to avoid or minimize uncontrolled soil displacement. Most roads needed for timber removal at SRP are already in place.

Prescribed burning for pine site preparation is used to reduce the fire hazard (tree tops, needles, and leaves), to kill small hardwood stems back to the root collar, and to kill unwanted small pines. This gives the planted pine a chance to compete with the vegetation already onsite. It also increases wildlife food supplies by improving the yield and quality of herbaceous plants. Prescribed burning does contribute to a change in the air quality and has a short-term undesirable visual impact.

Herbicides are used for pine site preparation to reduce the small hardwood stems and other vegetation back to ground level. This also gives the planted pine a chance to compete with the vegetation already on site. Sprayed areas are unattractive for several years and can be detrimental to wildlife for a short time. Mechanical site preparation for pine regeneration is also used to reduce the fire hazard and to reduce hardwood stems and other vegetation back to ground level. Mechanically cleared areas are unattractive for several years and can cause soil displacement until the area revegetates. Insecticides and prescribed burning may be necessary to control insects and disease.

General Effects on Water Quality

Timber harvesting has an impact on both quality and quantity of water reaching streams. For one to six months (depending on whether it is in the growing season or the dormant season), the water quality can be affected by soil disturbance from logging and road construction. Water yields, especially during summer months, can be expected to increase for several years after logging due principally to reduced evapo-transpiration. However, increased yields for major stream systems are difficult to detect because only small portions of the total watershed are in a recently harvested condition at any one time.

The Savannah River and all major streams on the Savannah River Plant are zoned for special management. Timber harvesting in this Water Influence Zone is planned to reduce soil disturbance and to prevent an increase in temperature of the water. Properly managed prescribed burning should not adversely affect either the quality or the quantity of ground or surface water in the southeast U.S. Relatively small areas are burned at one time and they are interspersed among unburned tracts.

General Effects on Air Quality

Equipment used in timber harvesting causes some air pollution. Leaf and needle litter, understory vegetation, and tree mortality plus tree tops from logging create a fire hazard, hence a potential air pollution problem. The most common method used to reduce this hazard is prescribed burning. Both wildfires and prescribed fires contribute to changes in air quality. The advantages of using prescribed fire are weighed against detrimental effects of wildfire on air quality. In Coastal Plain areas of high fire occurrence, it is estimated that without a vigorous prescribed burning program the acreage burned by wildfire would increase sevenfold.

THERMAL EFFECTS ON THE RIVER AND THE SITE

Water quality standards for the Savannah River were revised in 1972 by the South Carolina Pollution Control Authority and approved by the Environmental Protection Agency (EPA). The standards that pertain to temperatures are:

- The water temperature shall not exceed 90°F (32.2°C) at any time after adequate mixing of heated and normal waters as a result of heated liquids.

- The water temperature after passing through an adequate zone for mixing shall not be more than 5°F (2.8°C) greater than that of water unaffected by the heated discharge.

- The mixing zone shall be limited to not more than 25% of the cross-sectional area and/or volume of the flow of the stream and shall not include more than one-third of the surface area measured shore-to-shore.

Savannah River Plant operations satisfy all three of the water quality standards on temperature in the Savannah River as summarized in Table III-31 and discussed below.

Maximum Temperatures, Mixing Zones, and Effects *on the Savannah River*

The maximum daily temperature recorded below the plant by the USGS since measurements were begun in 1958 was 29.4°C. This temperature occurred on August 25, 1959, when four reactors were discharging heated effluent to the river. This temperature is well below the maximum (32.2°C) imposed by water quality standards. More detail is provided in Appendix B.

Temperature distributions on the Savannah River near egress of the heated effluents from Beaver Dam Creek, Four Mile Creek, and Steel Creek were made to determine mixing zone areas. The mixing zone in the Savannah River below Beaver Dam Creek is negligibly small. The mixing zone below Four Mile Creek covers 14% of the cross-sectional area. The mixing zone based on surface area is about 23%. The mixing zone below Steel Creek is less than that below Four Mile Creek. Further details are given in Appendix B.

The Limnology Department of the Academy of Natural Sciences of Philadelphia has carried on a continuing program of scientific investigation in the Savannah River, beginning with a baseline study in 1951. The baseline study considered all the major groups of aquatic organisms - the protozoa, lower invertebrates, insects, fish, and algae - together with the general chemical and physical characteristics of the river. Since the baseline study, the program has consisted of spot checks four times yearly, detailed surveys at 3- to 5-year intervals, and continuous diatometer studies. The 1951 to 1970 summary report of these studies[31] concludes that "there was no evidence in any of the areas studied of the effects of increases in temperature in the river caused by activities of the Savannah River Plant."

TABLE III-31

Compliance by SRP with S. C. Standards for Temperatures in the Savannah River

Criterion	*Standard*	*Maximum SRP Value*
Maximum temperature below SRP after mixing	32.2°C (90°F)	29.4°C[a]
Maximum temperature increase	2.8°C (5°F)	1.4°C[b]
Maximum mixing zone (% of cross-sectional area)	25%	<20%
% of surface area	33-1/3%	<25%

a. Maximum recorded below SRP.

b. Calculated using classified information for two reactors discharging to the river, at minimum river flow.

Thermal Effects on Plant

The streams that have carried the reactor cooling water effluents were originally shallow, slow-moving streams. An unavoidable consequence of increasing their flow to many times the natural value was to cause them to overflow their banks along much of their length. Several species of trees and other vegetation were unable to survive this flooding; others were unable to withstand the higher temperatures in the streams nearer the reactors. The discontinuance in 1968 of the use of Steel Creek for heated discharges has resulted in a partial recovery of the flora and aquatic life. Vegetative succession is progressing, and fish have repopulated the creek.

The heated discharges to the swamp along the Savannah River have altered the floristic composition of the swamp. The canopy has been removed in the thermally affected areas. Plant species diversity indices in the thermal and post-thermal recovery areas are similar to that of the natural swamp understory on the SRP and to other forest ecosystems. But of 101 plant species recorded from the swamp sampling areas, only 9 species were common to the undisturbed swamp area, an area receiving thermal effluents, and a post-thermal recovery area. The high diversity of herbaceous plants in the thermally affected areas is caused by the creation of "island habitats" formed by the fallen trees and stumps. Bird species composition and diversity follow the same pattern as the plant composition and diversity.